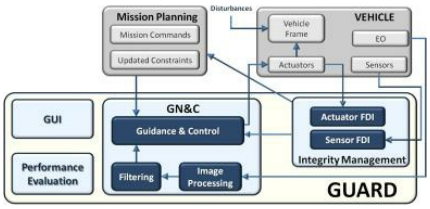
Active Project (2015 - 2017)

Generalized gUidance, Navigation & Control Architecture for Reusable Development (GUARD): Performance Evaluation in Relevant Operating Environments, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

In Phase I of this project, SSCI carried out initial development of the Generalized Guidance, Navigation & Control Architecture for Reusable Development (GUARD). The resulting framework is applicable across different Autonomous Rendezvous and Docking (AR&D) domains, and enables further development and testing of reusable GN&C software for such applications. GUARD is based on the key functional requirements for GN&C software for AR&D, with special emphasis on the commonality across different domains of operation and unique implementation requirements for GN&C algorithms in such domains. Phase I accomplishments include: (i) Augmented the flight-test proven on-line trajectory optimization and control algorithm with a Fault Detection, Identification and Accommodation (FDIA) capability, (ii) Extended SSCI's Vision Based Navigation (VBN) algorithms, recently demonstrated for shipboard landing flight experiments, to achieve centimeter-level positioning accuracy for the AR&D implementations, and demonstrated its robustness to docking pattern variations; (iii) Carried out a detailed study of common GN&C functions for AR&D, and developed a conceptual solution for a user interface enabling agile reconfiguration of domain-specific information; and (iv) Carried out initial analysis of System-level Performance Metrics for AR&D missions to facilitate V&V of the overall integrated GN&C system. Phase II will demonstrate an enhanced prototype of the GUARD with integrated GNC/FDIA/VBN software that will make it reusable in three disparate AR&D system domains. Demonstrations will be in simulation and hardware tests as follows: orbital AR&D (in simulation), planetary rover docking with a habitat (evaluations at Olin College on R-Gator platform), and a quadrotor close-proximity operation mission (evaluations at UT Austin on quadrotor platform). Phase III will focus on commercialization of the GUARD software and its implementation to future NASA



Generalized gUidance, Navigation & Control Architecture for Reusable Development (GUARD): Performance Evaluation in Relevant Operating Environments

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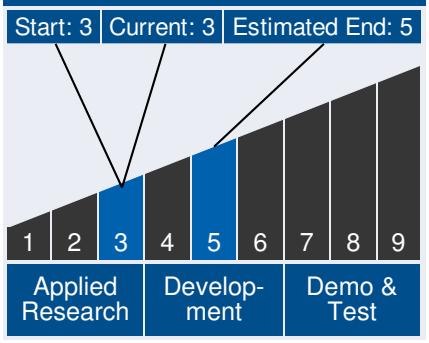
Technology Maturity



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Space Exploration missions.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: Immediate applications of GUARD are envisioned in the NASA Space Exploration Programs and future missions whose important components are AR&D tasks and close-proximity operations. GUARD technology has a potential to supersede point design methodologies and result in substantial cost savings in the development of GN&C software. Another family of missions that will benefit from the GUARD technology are space landing missions on planets, asteroids and other celestial bodies. The MICP-based optimal trajectory planning and control software, originally developed by our team member Prof. Behcet Acikmese, is becoming the standard for next generation Mars missions and has been funded by NASA Flight Opportunities program for maturation and test validation. Augmenting the MICP algorithm with FDIA and VBN capabilities under the GUARD framework will be a major thrust for our future research in this area.

To the commercial space industry:

Potential Non-NASA Commercial Applications: Another important application area for the GUARD technology is autonomous UAV/UAS markets. GUARD will be particularly well suited for the delivering a GN&C software toolkit that has been designed and evaluated for UAV teams for missions such as autonomous formation flying and aerial refueling. From the GN&C system design and functionality perspective, such missions have many commonalities with AR&D space missions and missions involving close proximity operations.

Management Team

Program Executives:
- Joseph Grant
- Laguduva Kubendran

Program Manager:
- Carlos Torrez

Principal Investigator:
- Joseph Jackson

Technology Areas

Primary Technology Area:
Robotics and Autonomous Systems (TA 4)
- Autonomous Rendezvous and Docking (TA 4.6)
  - Docking and Capture Mechanisms and Interfaces (TA 4.6.3)
    - Docking System for Exploration (TA 4.6.3.2)

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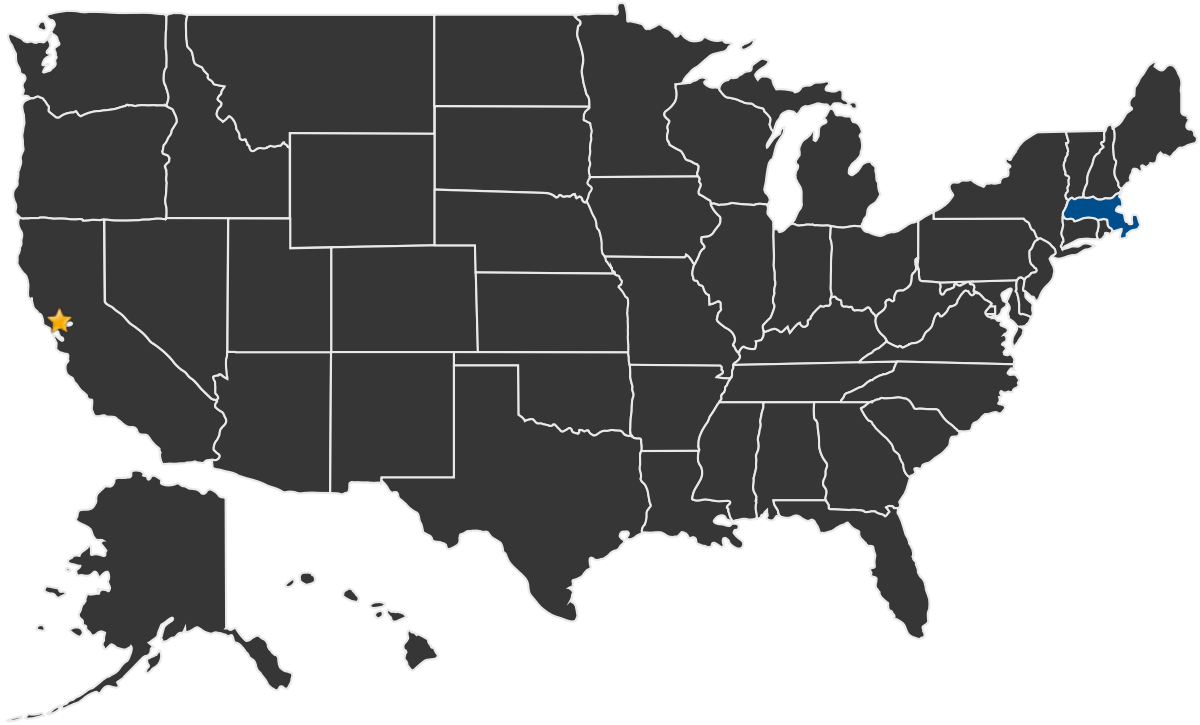
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Ames Research Center

Other Organizations Performing Work:

- Scientific Systems Company, Inc. (Woburn, MA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/18019)

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DETAILS FOR TECHNOLOGY 1

Technology Title

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